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SPECIALIZATION AND FUNDAMENTALS IN BOTANY¹

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It was my pleasure and good fortune to assist in the launching of the parent society of the present Botanical Society of America, an event which took place somewhat more than a quarter of a century ago. American botany was a lusty youngster among the sciences at that time, but was not generally regarded as capable of doing a man's work in this work-a-day world. It was in good repute within limited circles, but was not consulted when large enterprises were in hand. Even fellow botanists abroad felt no compelling inclination to recognize the work done in America.

Realizing that this condition ought not to continue, steps were taken to organize a society which should exemplify the best thought and endeavor of American botanical activity, and especially should promote higher attainments and a greater amount of original investigation. In order to finance the movement the members were willing to tax themselves with heavy annual dues. The results were increasingly encouraging. After a decade the society united with others into the present more democratic, less burdensome, and more diversified organization, which now stands as the peer of any association of its kind, either at home or abroad.

It was a happy thought to introduce a banquet into the annual program of the society. There may be those who do not see how eating a good meal once a year in the presence of one's associates can aid materially in increasing the amount and quality of scientific knowledge or give a keener zest to the pursuit of discovery. They overlook the subtle relation that exists between bodily good cheer and intellectual elation. Undoubtedly the employment of savory viands to promote fellowship is as old as the habit of eating, and why should not the same agency be carried a step further and made to promote the cause of research? I speak as if it were a new idea. Yet at a date ten times as long ago as the life of this and its parent society the great investigator, Harvey, discover of the circulation of the blood, took this means to increase interest in research. In 1656, a year before his death, he gave his estate of Burmarsh in Kent to the Royal College of Physicians of London. In doing so he stipulated that once a year a general feast should

¹ Address of the retiring president of the Botanical Society of America, read at Chicago, December 29, 1920.

be held within the college, and on that day an oration should be delivered exhorting the fellows and members to search and study out the secrets of nature by way of experiment, and also, for the honor of the profession, to continue in mutual love and affection among themselves. Clearly there is illustrious and time-honored precedent for the Botanical Society of America to issue its invitations to "come and eat four grains of rice," as the hospitable dweller in Venice would phrase his most cordial request for your presence at dinner.

I have chosen for my remarks this evening a title so inclusive that, to relieve apprehension regarding any intention to be encyclopedic, I feel it incumbent to state at the outset that it is only a camouflaged sophomoric trick to secure the opportunity for more or less disconnected comments, although on that account, I trust, not less timely or weighty. I propose to speak from the point of view of the investigator and advanced student, rather than from the more usual pedagogic one of the schoolmaster or pupil.

But first of all permit me to revert to Harvey's suggestion that for "the honor of the profession" the members cultivate "mutual love and affection." In the earlier days of botanical organization in America, the kind of organization that first attempted to embrace the length and breadth of the country, the inspiration for which came through the American Association for the Advancement of Science, there was a predominant homogeneity of sentiment and good will with mutual confidence. That was a period not so remote as to be beyond the memory of some of us. In the main that condition still exists. If in some particulars it has been violated, a remedy could be and should be applied.

When making a tour of European universities and experiment stations some thirty or more years ago, I was particularly struck by the reluctance of many botanists in the German institutions to speak openly about their unpublished investigations. There seemed to be a feeling that, should they disclose any part of what they had accomplished, or had in mind to undertake, some colleague might rush into print and deprive them of their honors. It was not the precaution demanded in an older and more densely settled country against the irresponsible and lawless, causing the Germans to put two locks on each door, while in my western home we did not turn the key in the one lock that might happen to be there. It was rather a distrust of one's fellow workers, a state of mind we have learned to associate with a certain type of bureaucracy; and every German professor was at that time a government official. It seemed to me most absurd and uncalled for, quite unbecoming highminded, conscientious, and trustworthy men of science. Since then, some of the same spirit of exclusiveness and distrust, possibly with a tinge of selfishness, has occasionally become manifest in American botanical circles, and it is not surprising to find that it crops out most from government centers. It would be natural to suppose that those who are paid and supported in their scientific work from funds derived

impartially from all the people would feel that their first obligation was to the public, at least to the scientific part of the public. But such is the insidious influence of centralized power, or, as G. R. Lyman says, "the zeal of public service," that in some quarters the wealth of opportunity and material are guarded with miserly oversight for the advancement of particular workers and the prestige of the organization. I am not speaking of the individual. There are always a few lacking in a nice sense of propriety and the distinction of *meum* and *tuum*, who must be guarded against. My experience leads me to believe, however, that they are few in botanical circles, both in this country and abroad. What I have in mind is the spirit of exclusiveness, the dog-in-the-manger policy, which should be frowned upon, and so far as possible eradicated from all efficient and truly democratic centers for scientific work. Otherwise, how are we to bear out Harvey's admonition "to continue in mutual love and affection" for "the honor of the profession?" The man of science should be able to appreciate and exemplify what Chaucer means when he says of his knight, that

he loved chivalry,
Truth and honor, freedom and courtesy.

At the present day all botanists are specialists. The expansion of the science under many diversified heads, linking it up with other sciences, and the desire to excel in some restricted field, rather than to be content with the level of general information, doubtless explains much of this tendency. With increase in the number of botanical workers has come an increase in the number of organizations bearing distinctive titles. So speedy and intense has been this movement that it has carried some of the younger members of the profession quite off their feet, and in the rarefied atmosphere of their new environment they no longer see the solid earth from which the maintenance of their strength must come. Oh, no! they say, I am not a botanist, I am a pathologist, an ecologist, a geneticist, or what not. Let us hope that the allurements of the silver-lined clouds of science will not keep them from eventually considering the mists that bedew the earth and renew its verdure.

Probably the most fundamental thing that the specialist is likely to neglect is an intimate acquaintance with the plants with which he deals. When the distinctive instrument of the botanist's labors was the vasculum, now rarely seen, and to be credited with a knowledge of elementary botany required one to pass in fifty named and mounted specimens, only the indolent missed a suitable basis for botanical advancement. When the microscope became the botanist's chief instrument, the foundations began to be neglected in the construction of the multivariied details of the superstructure. With the advent of other instruments of research, the microtome, the auxanometer, the atmometer, etc., attention was directed more and more away from the individual plant as an interesting inhabitant of the

organic world. The study of structure, physiology, or behavior has often proceeded with inadequate knowledge of the position that the particular plant under observation holds in relation to other plants, its resemblances and differences as compared with its kin, near and remote. When Gray's *Lessons in Botany* was superseded by the general textbook that began with slime molds and ended with sunflowers, there did not seem to be time to make the acquaintance of particular plants, and when a little from each topic pertaining to the varied structure and action of plants from the cytology of the cell to the sensitiveness of a tendril had to be interpolated, the plant as an individual member of an evolutionary group was overshadowed. The great English botanist, Sir Joseph Hooker, once wrote to Dr. Asa Gray:

I content myself with a casual grin at young men calling themselves botanists, who know nothing of plants but the "innards" of a score or so. The pendulum will swing round, or rather back, one day.

It is already on the way; let us hasten the movement.

The botanist's realm is the vegetable kingdom. As the man of the world is able to assign each person he meets to a particular race, country, or section, with more or less accuracy, to have some individual acquaintance with a few here and there, but knows only those within a limited circle sufficiently well to call them by name and to be familiar with some of the facts of their history, so the botanist should have a general knowledge of plants of all countries sufficient to enable him to place most of those coming to his attention within certain orders or families, to know a few by name, and with those he meets frequently, especially the flowering plants, to have the same familiar acquaintance of name, characteristics, and behavior, which he prizes for his speaking friends. In the realm of plants the botanist has a distinct advantage over the man of the world, for he has manuals which enable him to ascertain the name of the plant he wishes to know, and to be unfamiliar with such manuals is to write oneself down inadequately equipped for his duties. My attention has been most frequently called, perhaps, to the shortcomings of the cytologist, who essays to throw light on the relationship of parasitic fungi by a discussion of his observations without taking full precaution to make sure of the exact identity of the material he has used, or of the kinship of the forms he has selected for comparison. In this way laborious and extensive studies may fail to exert due influence, and may have their chief value confined to a record of the particular observations. But no class of investigators need be credited with an unwarranted share of haphazard interest in the exact identity of the plants handled. I fancy the bacteriologist and the paleobotanist have the best reasons for being uncertain. There is a joke, with which you may be familiar, that, when puzzled about the affinities of a plant, "fossilize it and send it to a paleobotanist, and he will give you the genus and species at once." The students of microfungi are not to be outdone in this particular. Among

parasitic forms the relation of the fungus to the host is very intimate, and the identity of the one often involves that of the other. Examples are numerous where the name of the host has been adopted for the fungus growing upon it, only to learn later that due care had not been exercised by the original collector and that the host was not what it purported to be, the name thus becoming a misnomer. In general, probably, a considerable percentage of the inaccuracy and misinterpretation in various fields of botanical science is traceable to a lack of intimate acquaintance with plants as living objects having distinctive names and varied relationships.

While systematic botany may never again have the place of honor in the curriculum that it held in the post-Linnaean days when Jean Jacques Rousseau wrote his delightful letters on the elements of botany, and coming down to the days of our own beloved Asa Gray, yet no man who essays to explore the domain of plant knowledge, whether as student, investigator, or philosopher, can afford to be without an understanding of its main tenets, based upon spirited contact with the plants of the field and upon ability to localize and identify individuals engaging his attention.

As somewhat of an accompaniment to these thoughts, but quite as an independent theme, I bespeak consideration to the matter of names. So fully have the taxonomists been shoved aside in recent years that devotion to the task of disentangling, rectifying, and correctly assorting the mass of names in any group of plants appears to many botanists as a work of supererogation, largely futile, and almost finical. They are reputed to be meddlers, with a penchant for displacing well known names by unfamiliar ones, and possessed of an insatiable and egotistical desire to see their own names appended to as many Latin designations as unlimited juggling may seem to give warrant. Moreover, there is apparently a feeling that there are names enough in use, at least enough for all except a few rare species in out-of-the-way regions yet to be brought to light by explorers; and that if the nomenclaturists would let them alone we should not be obliged to learn a new set of names, and to puzzle over their identity with the old ones, every time a fresh work on botany comes from the press.

There is plenty of justification for irritation over the nomenclature situation. All will agree that each plant should have its fixed name independent of any particular botanist's certification. But we are far from that goal at present. Why? Is it an impossible goal, or do we needlessly muddle the situation and retard progress?

Of course every active systematic botanist knows how false is the prevalent idea that most plants have been sufficiently studied to make their identification as species no longer uncertain. Let it be remembered how few years ago it has been since we became aware that the plantains and dandelions in our lawns were not each one species, as the botanical manuals stated, but that each comprised two species and well defined. In my garden I have grown for a number of years a delectable small fruit,

that I have seen listed horticulturally as Garden Huckleberry, and that evidently belongs to the great genus *Solanum* or one of its segregates, but I have been unable to find it described in any botanical treatise at my command. There may be, and doubtless are, other plants in our front yards and vegetable gardens whose naming is uncertain for lack of sufficient study, and how much more so must be the case of plants in forests, fields, and mountains, and in the botanically unexplored regions of our own and other countries. What is true of the larger flowering plants is even more applicable to the far greater numbers of the less conspicuous lower orders of plants.

The introduction of any number of new names, when discriminately applied to really new species, is not a source of embarrassment, but an aid to better understanding. The trouble arises when two botanists in different parts of the world independently give different names to the same plant, or when a name is applied to a species supposed to be new but afterward found to have been named, or when some one ascertains that a name has been badly chosen, is inapplicable, or of faulty construction, or when the demands of classification seem to require the transfer of a name from one genus to another. In such or similar cases, which are exceedingly numerous, the choice of rival names is still largely a matter of personal preference, although from the days of De Candolle attempts have been made to formulate guiding rules, which have been of more or less service, but never generally accepted. It is the opinion of Mr. C. G. Lloyd of Cincinnati, whose trenchant pen has scored many present-day mycological nomenclaturists for their pedantic ways, that the value of a name should be derived from "historical truth and general use." He believes that "if mycological writers in general would rely on these principles alone in the selection of names, it would only be a short time until we should be in practical accord." The principles seem simple, and if they would serve to secure acceptable unity for mycological names, they would doubtless serve as well for all other plant names. Certainly the great desideratum for names is their general acceptance, so that the same name always applies to the same plant in the writings of all authors. More than a century ago, when the controversy was raging in this country over the comparative merits of Jussieu's natural system and the artificial system of Linnaeus, Thomas Jefferson, "one of the six greatest men in the history of the public life of the United States," as a recent historian has stated, a broad-minded statesman and a man of high scientific attainments, contended that in this connection no matter was "so important a consideration as that of uniting all nations under one language in natural history." The committee on nomenclature appointed by this society is endeavoring to aid in such a movement. As no rules to govern the names of plants can be made mandatory, their general acceptance must necessarily depend upon their appeal to precision and serviceableness, as well as upon the provision they make for authentication in doubtful cases.

As already indicated, the regulations for selecting and validating the correct name of a plant have been slow in taking shape. It has long been recognized, more and more strongly of late, that the name first given to a particular species of plant must be considered its proper and legal name. The difficulty has been to secure agreement upon the particular name to be considered as having precedence. The difficulty is somewhat the same as the courts of justice have in proving that the name on the docket properly belongs to the person before the bar. The latest move among nomenclaturists is to follow the methods of the law courts, wholly abandoning the attempt to prove that the name is correctly used and being content with making sure of the identity of the person in question, or, in botany, establishing the identity of the particular specimen of plant which was in hand when a name was published. This is known as the type-basis method, and promises to bring definiteness and exactness where before was the uncertainty of individual interpretation. Nature has not provided us with species and genera, but only with individuals having greater or less resemblances. As botanists we find it convenient to treat individuals possessing a certain amount of resemblance as species, and these species we group into genera. The size and variability of the units we call species and genera will depend in each case upon the taxonomic views held at the time, but the name, according to the type-basis method, must always find its application in accord with the characteristics possessed by the original specimen upon which it was founded.

Having now said something about the desirability of knowing plants at first hand, and about the application of their names, permit me to say a few words about the names themselves. Since the days of Linnaeus, names of plants have been binomial, with tendencies now and then to become trinomial, quadriminomial, or even multinomial, but never monomial. Evolution of the onomatology of plants has many parallelisms to that of persons. In the early days, that is, before the middle of the eighteenth century for plants, and before the tenth century for persons, names either of plants or of persons might consist of a single word, or on the other hand might be of indeterminate length. For persons there was a gradual evolution into a surname and given name, while for plants a far more rapid change brought about the corresponding generic and specific name. The names of persons are not established by law, but by usage. The first name applied to an individual, however obtained, is almost invariably accepted in after years, and yet there is no law in this country or in England, and certainly not elsewhere, against changing a name; nevertheless, certain states have provided a process by which a change may receive legal sanction, if such is desired. The case of plants is almost identical, except the last provision for validating a name. But the movement is well under way to provide fixed rules to serve as a guide in the bestowal of plant names, to indicate the correct names previously given, and to secure their maintenance, which

should eliminate much of the present confusion; even the provision for validating a name by a fully authorized tribunal, when a change is desirable, is being considered.

In other ways the usages regarding personal names and plant names show a similarity in evolution. In the earlier days personal names usually denoted some quality or distinction in the individual, fanciful or real; as Clovis, glorious warrior; Mathilda, mighty amazon; Adolf, the noble wolf; Cicero, the vetch-grower. When surnames came into use they were at first selected in much the same way, as Rich, Noble, Black, Brown, Archer, Goldsmith. But after a time the multiplicity of names, and the necessity of continuing their use when no longer applicable, led to the present usage of disregarding the qualifying significance in either surnames or given names, and to select them for euphony, or family association, or fanciful reasons. The course with botanical names has been much the same, but the evolution has not gone as far, doubtless because of the shorter period of time involved. For a while it was thought necessary to give descriptive or informative names to plants, and when they proved inappropriate to change them. But the practice has largely fallen into disuse in late years. *Plantago major* is a much smaller plant than the similar and more common plantain that grows with it everywhere in this country east of the Rocky Mountains, yet the name has not been changed. Some taxonomists, however, who deal with the lower orders of plants, especially the fungi, are still in the dark ages with their nomenclatural practice. A rust called *Puccinia Distichlidis* has been renamed, because it was found that the grass on which it occurs is not *Distichlis*, but only looks like *Distichlis*. In another group of fungi a prominent writer stated not long ago that

We have heretofore used *Cyathus Poeppigii* as the name for this species, but in the future we shall adopt the name originally applied to it by Poeppig. We do not do this on any ground of priority, but because *Cyathus Poeppigii* is a heathenish kind of name that ought to be suppressed.

Within the last month or so a transatlantic colleague has written regarding a species of *Helminthosporium*:

May I point out the course we have adopted with regard to the spelling of the specific name of the barley stripe fungus? We now invariably use *graminum*, the genitive plural of the substantive, believing this to be more correct than the adjectival form *gramineum*.

One might cite many instances to show that, although the latest rules of nomenclature do not sanction changes like these, we are yet slow in arriving at the stage at which the name of a plant, like that of a person, is generally considered as an appellation wholly for identification, and whatever of descriptive or adjunct information it may convey must be considered entirely incidental or historical.

Curiously, we speak of the name of a plant or person as if it were a simple designation, like a number. Yet it is a compound of two very

unequal parts. When we say that the correct name of a plant is the one first applied to it, we mean the specific name only, the one corresponding to a person's baptismal name, and it is toward this part of the name that most of the rules on nomenclature are directed. The specific name may be transferred from one genus to another as many times as seems desirable, in order to express its relationship, just as a woman's surname changes upon remarrying, or a man may take another surname to meet the requirement of a bequest; but the identity of the plant as of the person is inherent in the specific or baptismal part of the name, although standing by itself it would mean little. Thus the common field thistle, which we usually call the Canada thistle, was named by Linnaeus *Serratula arvensis*. At intervals of a few years it was successively transferred by different authors of the old time to the genera *Cirsium*, *Carduus*, and *Cnicus*, but at present is most generally listed as *Cirsium arvense*, I believe. Again, Linnaeus called the common dandelion, that makes our lawns glorious with golden bloom in spring and later turns them into a ragged waste, *Leontodon Taraxacum*, the specific name being adopted from an old-time classical name. Later this genus was divided, and the dandelion dropped into the new genus *Taraxacum*, it being called *Taraxacum densleonis*, which had the same meaning as did the first name. But it is now contended that the earliest specific name is the rightful one, irrespective of meaning, and in consequence the dandelion should be called *Taraxacum Taraxacum*, which strangely enough is a combination that is strenuously objected to by a large number of botanists. Why should this and the like combinations, *Sassafras Sassafras*, *Abutilon Abutilon*, etc., be any worse names for plants than William Williams and Smith de Smith for persons? Until we bring ourselves to look upon plant names as simply names, not qualifying terms, our science will be handicapped by the impedimenta of prejudices whose rightful place is in the musty volumes of the antiquary.

Now a word about those appendages of every Latin botanical name, which C. G. Lloyd calls the personal advertisements. In the present unsettled state of nomenclature they are as necessary for keeping names from going astray as the tail is necessary to guide a tadpole. When plants become better known, and names are more consistently applied, the caudal appendages will be dropped as burdensome and useless. To get us out of the tadpole stage in nomenclature, however, will assuredly take united effort and willingness to forego prejudices. Every botanist should be interested in hastening the day. Whatever one's specialty, he must use the Latin names of plants. Exact names, uniformly applied, are a fundamental requirement of the science, and it is in the interest of every botanist, as well as of horticulturists, agronomists, and all other users of plant names, to hold a favorable attitude toward attempts to secure this end.

At this point I am reminded that the most prominent feature of the present movement in botanical thought is organization and coöperation.

We are clearly entering a new era for scientific labors. Research has become the watchword of the hour and is to be encouraged more than ever before. In course of time it may even be acceptable and intelligent to officialdom for one to give his occupation as *investigator* and not to be obliged, as at present, to masquerade as a *teacher*, even when he does no teaching and possibly may not be connected with a teaching institution. It is now commendable not only to encourage the spirit of research, but to assist in providing a general atmosphere favorable to its development. Naturally, as in other movements that become popular, there is sometimes more talk about the value and desirability of research, than actual accomplishment, or even hearty direct assistance in providing time and means for its prosecution. Nevertheless, we are likely to see the number of research centers, both great and small, much increased, and the ranks of those who essay the task of adding to available knowledge immensely augmented.

In the re-awakening and re-orientation of the research spirit it should be possible to preserve and advance that fine democratic quality which recognizes, as we were reminded by one of our number two years ago at the Baltimore meeting, that "botany is a world science and that its advance can not be accelerated through the usual operation of institutional or individual rivalries." There must be the fullest and freest coöperation between institutions, and quite as much between individuals, both as members of organizations and as independent workers. Harvey's exhortation to mutual consideration should find practical fulfillment, both for the good name of the profession and for the efficiency of its labors.

While I am pleading for individual freedom and encouragement against the encroachments of the machinery of organization, I do not undervalue the great service and importance of associations, both those of voluntary combinations of individuals and those centering about institutions. I subscribe most heartily to the views of Mr. Frederick W. Taylor, who had in mind especially the research conditions in the commercial world, but whose words are equally applicable to things botanical, when he said:

The time is fast going by for the great personal achievement of any one man standing alone; and the time is coming when all great things will be done by that type of coöperation in which each man performs the function for which he is best suited, yet preserves his own individuality and initiative and is supreme in his particular function, while controlled by and working harmoniously with many other men.

These words breathe the true democratic spirit of personal freedom as against the bolshevistic absorption of the individual in the organization.

In the movement for greater accomplishment by means of organization the class of problems which are uppermost for consideration are the economic ones, or those which can be justified by a direct popular or commercial demand. These are the ones for which money can be most readily obtained, and in which the largest number of persons can be interested. These are the ones chiefly supported by the general government, because they are

nearest to the interests of the taxpayer to whom the government must appeal for funds. They are most likely to receive attention from state institutions whose success depends upon heeding the popular demand. Even privately endowed educational institutions and detached research institutions can not help but be influenced by this tendency. Such problems have almost monopolized the word *specialize*. Thus Dr. Lyman says:

The agricultural institutions have specialized too strictly and have laid too little stress on the fundamentals of botany.

With the natural instinct to be interested in the under dog, my closing words shall be a plea for greater attention to the fundamentals in making provisions for organized support. The solution of problems falling in this class furnishes the tools for the specialist. Some phases of taxonomy, of which I have already spoken, might be used as an example. The consistent, effective onward march of botany calls for careful balance between the attention given to specialization and that given to fundamentals.